FINAL REPORT

Assessment of Septic Leachate:

A Survey of Lake McDonald

Glacier National Park

to:

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INTRODUCTION

Background

In fall 1987 and summer 1988, a survey of potential leachate contamination from cabin septic fields located along the Lake McDonald shoreline was conducted by M.E. Laboratory of Kalispell, MT. This survey focused on seeps and springs along privately developed shorelines, the Lake McDonald Lodge area located along the northeast shore, and the Apgar Lodge and Visitor Complex along the south shore. Sampling protocols and analytical procedures and techniques were restricted to measures of fluorimetry, dissolved organic carbon, and specific conductance. This approach relied heavily on the detection of possible fluorescing compounds leaching from the septic field(s) and entering shallow groundwaters that transport the leachates to the lake. The targeted fluorescing compounds come primarily from cleaning agents, in particular laundry detergents that employ the use of "whiteners" to enhance bright colors and whites of clothing. While this technique has been highly successful at identifying septic leachate problems around many water bodies, it has significant limitations in a setting such as Lake McDonald where many of the cottages are without electricity and have no laundry facilities. Nonetheless, several areas around Lake McDonald were identified in 1988 and 1989 as having an elevated fluorescence to dissolved organic carbon ratio (F:DOC), which would indicate possible presence of the laundry whitener. These sites also had increased levels of specific conductance that enhanced the validity of the F:DOC ratio data suggesting sites of possible contamination from leach fields. These sites are specified in the GNP report associated with Order # PX 1430-8-0495.

The first limitation of this approach is that it is relatively dependant on the introduction of fluorescing compounds into the septic field. Since this is done primarily by use of laundry detergents, the technique is immediately compromised whenever there is the presence of a septic field associated with a cabin that does not have laundry facilities. This is particularly common in cabins that are used for only short periods of time each year or that do not have electricity. The second limitation is the result of periodic use by cabin owners. The most successful use of the fluorescence technique to identify septic leachate contamination of a lake shoreline has been done where not only there are homes with laundry facilities, but also where there is continuous occupation. When cabins are used periodically, the flow of water into the septic tank and then to the leach field is discontinuous. This leads to the increased risk of making a false-negative determination or “type 2” error (i.e., non-detection of an existing problem). The third limitation is the result of naturally occurring fluorescing organics. Both fulvic and humic acids, which occur commonly in the environment and especially in groundwaters draining wetlands, have fluorescence properties. Thus, it is possible to obtain false-positive results or “type-1” error.

APPROACHES FOR STUDY

Shoreline Fluorimetry and Water Chemistry

We repeated the methodologies of the 1988-89 study for comparison of spatial pattern in potential problem sites using similar techniques. We used a continuous flow fluorimeter and a conductivity, pH and temperature meter to sample waters along the shoreline of Lake McDonald. Water from along the shoreline was pumped continuously by DC powered pump through a hose and then through the fluorimeter. The surveyed areas were along shorelines with cabins and

Park developments. We also sampled water for dissolve organic carbon, soluble reactive phosphorus (SRP) and nitrate nitrogen (NO_3) whenever we observed an elevation in either the electrical conductivity of the shoreline waters or an elevation in fluorimetric readings. The purpose of collecting water samples for laboratory analysis in these locations was that often the detection of fluorescing compounds, increased conductivity, and increased concentrations of soluble reactive phosphorus and/or nitrate nitrogen are indicators of leaching from septic field(s) into groundwaters or springs that transport the leachates to the lake.

Biomonitoring of Algae

Since the mid-1980's significant advances have been made in the scientific field of bio-monitoring. One of the advantages of using biological indicators of environmental change or impact is that the focus is on organisms that: 1) continuously sample the environment that they are living in and thus reduce that probability of missing periodic events, and 2) are sensitive to a range of impacts, from low levels to high levels of contaminants. One of the areas of limnology that has come into prominence, particularly during the past 10 years, is the use of algae as bio-indicators of nutrient enrichment. It has been documented for many years that algae are useful indicators of nutrient enrichment through their increased net primary productivity.

Remote Sensing

During the past 5 years, Flathead Lake Biological Station has been a pioneer in the development and implementation of airborne remote sensing. In this study, we used an ultra-high resolution, multi-spectral imaging camera to capture digital images at 5cm resolution. These data can also be used in the future for long-term monitoring and planning purposes. We also deployed a Hyperspectral Spectrometer to produce scene-data that allows us to detect zones of increased periphyton growth as a biological response to increased nutrient loading (primarily phosphorus and nitrogen) to a shoreline site from septic leachates and allowed us to couple broad spatial data with the biomonitoring of the algal growth. This instrument produces georectified images that capture specified, narrow band width data that we can classify by their reflectance of specific light wave lengths and thus high concentration of chlorophyll α wave-length emissions. Two significant advantages of this technique are the large areas that can be covered by remote sensing and its repeatability as a long-term monitoring tool.

Qualitative Dye Tracing

Dye tracing is the tracking of various flows using a highly concentrated and highly fluorescing dye added to water (or some other liquid medium). The purpose of tracing may be an analysis of flow or of the transport of something by the flow. Working with GNP resources staff and cabin owners, we arranged to have fluorescing dye introduced into the septic tanks and leach fields by the cabin owners in summer 2006. This part of the study required engaging the in-holding land owners for their cooperation. Conceptually, this portion of the study was to see if dye emerges in Lake McDonald directly from a septic leach field(s). We repeated the Dye Tracing in the summer of 2007 at selected locations that were identified in 2006 as “locations-of-concern” because of evidence from the Algal Biomonitoring, Fluorimetry and Water Quality, and Remote Sensing components of this study that suggested further exploration with dye testing was warranted. The dye used in this study is an organic dye that is readily decomposed by microbes in a septic tank or by sun light following emergence to the surface. Thus, the dye would only appear from a septic system that has totally failed and which had very rapid transport of the dye from the septic tank or leach field to the surface where it could be observed. While dye emergence is a definitive indicator of septic system failure, the lack of dye emergence cannot be construed as conclusive evidence that the septic system is functioning properly. For example, the septic system may be digesting organic matter (and thus the organic dye) very well, but yet allowing nutrient leakage from the leach field to enter the groundwaters and move slowly to the lake.

Objectives/Tasks

To achieve the goal of identifying continued or new potential sites of septic leachate associated with human activities around Lake McDonald in Glacier National Park, we followed a four-step plan: 1) a water chemistry survey focused on florescence and dissolved organic carbon (F:DOC ratio) and nutrient analysis (soluble reactive phosphorus and nitrate), 2) a biomonitoring assessment focused on periphyton growth, 3) remote sensing to detect areas of algal growth (as a biological response to nutrient loading from septic leachates), and 4) a direct-injection dye study in which a highly fluorescent dye was to be introduced into septic tanks and leach fields that would allow direct observation of septic leachate breakouts along the lake shoreline.

METHODS

Study Area

This study was conducted on Lake McDonald in Glacier National Park (Fig. 1) along shorelines having cabins or park facilities (e.g., Apgar, Lake McDonald Lodge). We divided the lake into the south lake shoreline (Fig. 2) and the north lake shoreline (Fig 3). Shorelines were further subdivided into specific sections corresponding with remote sensing high resolution imagery (Figs. 2 and 3) and designated Sections S1-3 and N1-13. Direct dye studies were attempted in conjunction with all cabins not connected to the central collection sewage treatment facility operated by the Park. Dye introductions were also conducted within the Lake McDonald lodge to verify that the transport system on pipe along the Southeast shore of the lake is not leaking. We conducted the fluorimetric and water chemistry studies along the lake shoreline. Sample numbers (1-29) are shown on Figures 2 and 3 and on the high resolution sectional images given in Appendix A.

Fluorimetry Survey and Nutrient Analysis

This portion of the project would largely repeat the field and laboratory analyses conducted in 1987 and 1988. While this technique has distinct limitations, it also can be very useful at identifying focal sites of contamination. Furthermore, as the technique employed in the last survey, it allows for direct comparison to results obtained ≈18 years earlier. Comparisons over time are particularly useful in identifying both sites that were an identified problem in 1988-89 and have been improved and sites that were identified earlier and remain a problem. We deployed a Turner Designs Fluorimeter from a boat that served as an instrument platform. Water was run through the fluorimeter continuously during the sample process. We initiated fluorimeter readings off shore to obtain background levels of fluorimetry and to calibrate the instrument. We walked and sampled water through the fluorimeter continuously along the shorelines. Wherever we observed either an increase in fluorimetric reading or an increase in the algal growth on the lake bottom, we recorded the fluorimeter reading and specific conductance, pH and temperature, collected a water sample for chemistry analysis and obtained an algal sample.

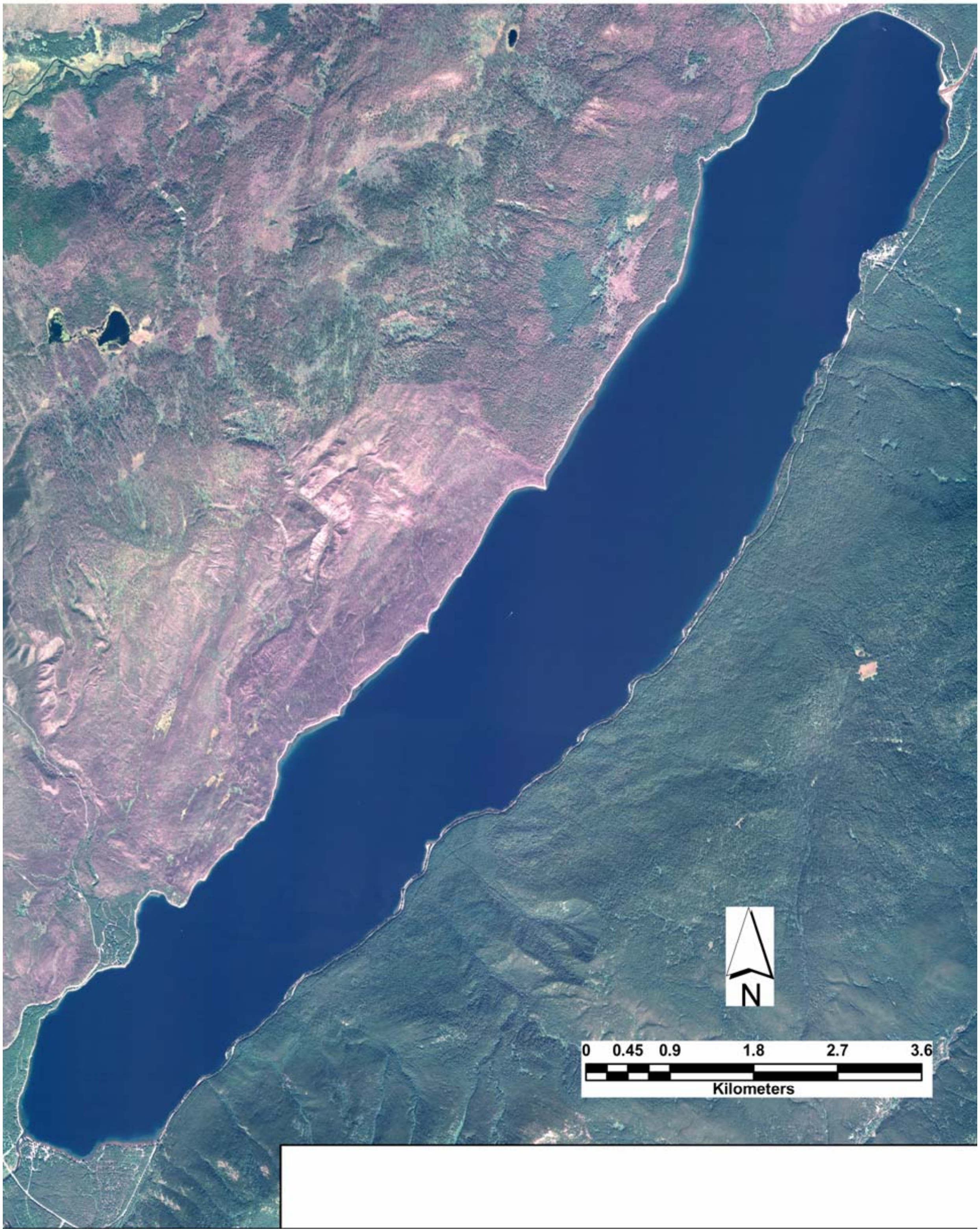

Figure 1. High elevation photo of Lake McDonald, Glacier National Park.

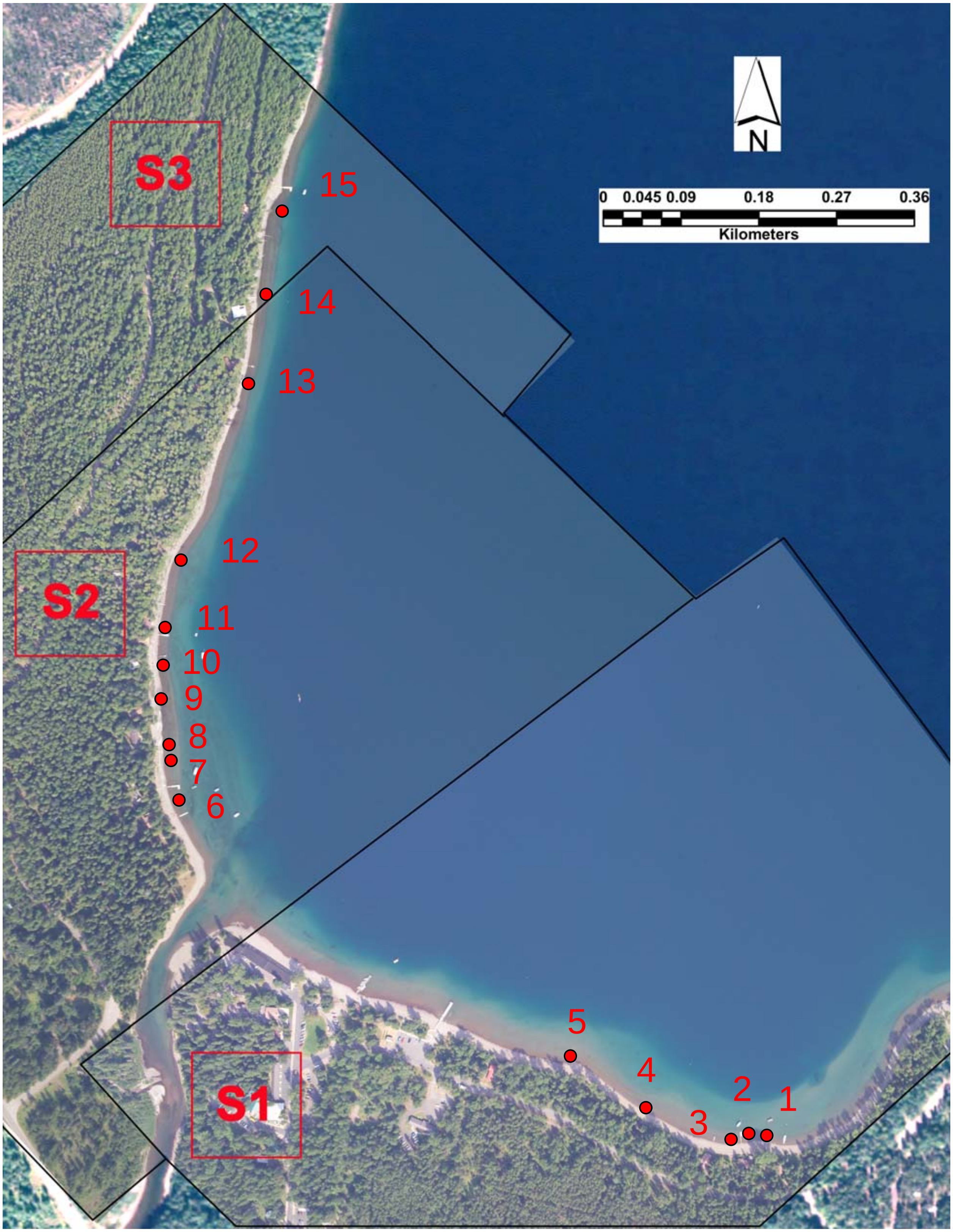

Figure 2. South Lake McDonald with high resolution digital multispectral images georeferenced to the base image. Numbers and red dots correspond to sampling sites. Sectional photos at higher resolution are in Appendix A.

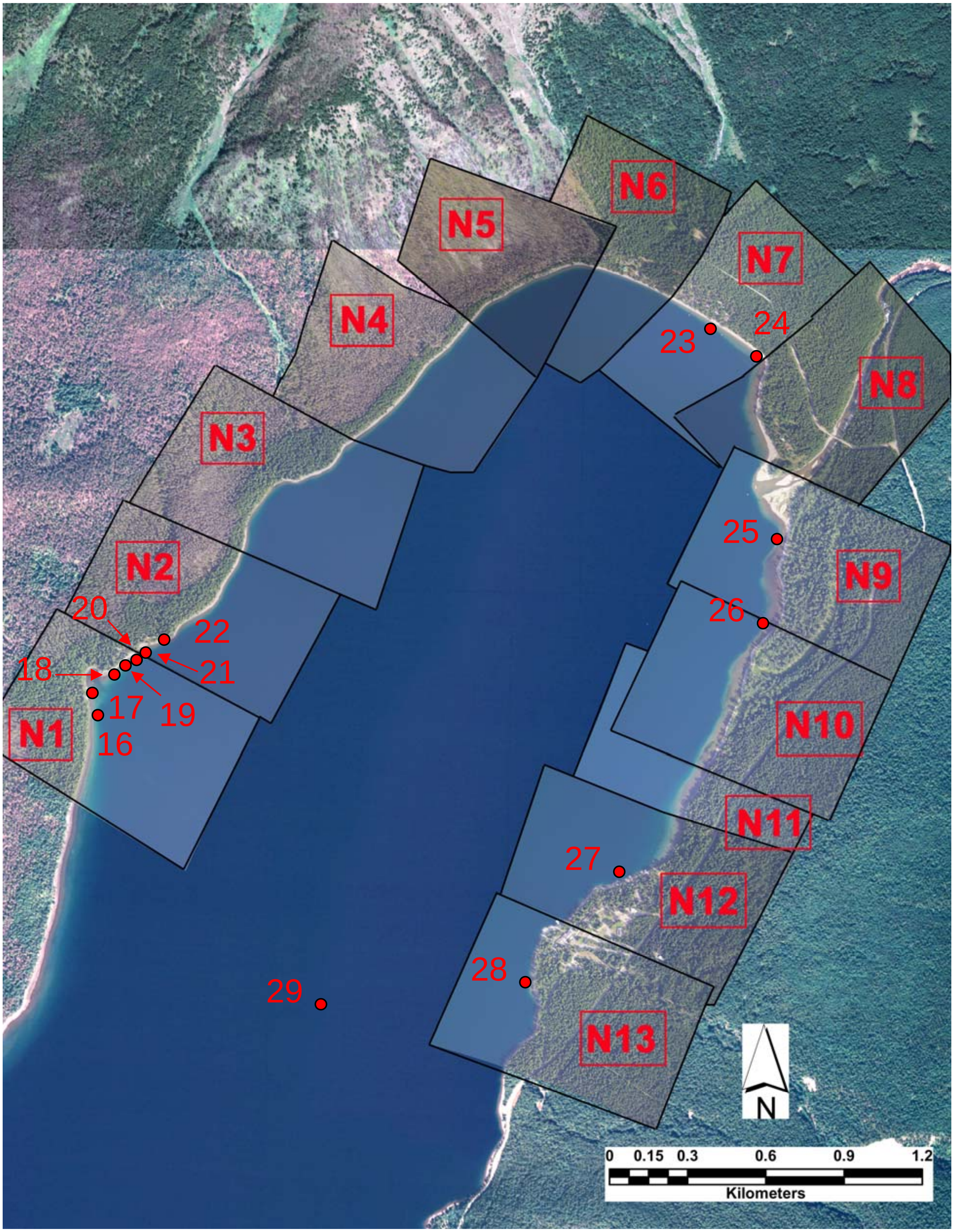

Figure 3. North Lake McDonald with high resolution digital multispectral images georeferenced to the base image. Numbers and red dots correspond to sampling sites. Sectional photos at higher resolution are in Appendix A.

Biomonitoring Assessment

We sampled each of the fluorimetric or algal “hot-spots” given above for the quantity of periphyton. Samples we processed in the field by scraping attached algae from 15.6 cm^2 of a selected submerged rock that was representative of the target area. The algae was concentrated onto a glass fiber filter, folded into an aluminum envelope to prevent either light from degrading the chlorophyll or desiccating the sample. The sample was than placed on ice and returned to the laboratory for analysis of Chlorophyll-a. Similarly, a sample was obtained in the same manner, returned to the laboratory, and analyzed for ash-free-dry-mass. Together these are a relative index of the quantity of algae and algal biomass on the shoreline.

Remote Sensing Assessment

Shoreline periphyton growth was also measured using the airborne multispectral and hyperspectral imagery. Hyperspectral and high resolution multispectral data were obtained using the FLBS/UM instruments and aircraft on August 21, 2006. Images were returned to the FLBS GIS laboratory, where they were georectified and analyzed for locations of increased algal production and classified with zones of high algal production suggesting areas that may have septic leachate contamination and increased nutrient loading.

Direct Dye Study

Rhodamine is a family of related chemical compounds called fluorone dyes. One of these, Rhodamine B, is used as a tracer dye in water to determine the rate and direction of flow and transport. We distributed dye packages for each private cabin along the shoreline of Lake McDonald. Each package consisted of a set of application instructions, latex gloves, and 20ml of Rhodamine B dye in a screw-cap vial. Packages were given to home owners during the last week of July with instructions to flush the dye down the toilet. The date of dye administration was to be July 29 - 30, 2006. I also administered dye into the sewer system of McDonald Lodge and at the NPS toilet facilities in Apgar. The dye study was repeated in summer 2007 at selected locations: A) at the west end of Kelly Camp, and B) along the northwest shoreline of the Apgar region among cottages that had not attached to the central Apgar sewer system. The 2007 dye tests were done as a follow-up to the 2006 dye studies because we identified increased algal growth and increased nutrient concentrations at these two generalized locations along the shoreline. In each case, 100ml of Rhodamine B was poured directly into the toilet by either NPS or FLBS staff follwed by 5-6 gallons of water administered by repeated flushing of the toilet.

RESULTS AND DISCUSSION

Fluorimetry, Water Chemistry, Algal Chlorophyll and AFDM.

A total of 29 samples were collected along the lake shoreline and analyzed for fluorimetric readings, water chemistry, and algal pigments and biomass (Table 1). These sites of analysis correspond to the shoreline section areas of Figs. 2 and 3 and seen at higher resolution in the Figures of Appendix A. From the suite of fluorimetric, DOC, water chemistry, and algal pigment and biomass data, we observed numerous locations that had no evidence of septic

Table 1. Results of Fluorimetry, Dissolved Organic Carbon (DOC mg/L), F:DOC ratio, Conductivity (umhos/cm), Soluble Reactive Phosphorus (SRP; PO_4 ug/L), Nitrate (NO_3; N ug/L), Ammonium Ion (NH_4; N ug/L), Chlorophyll-a (Chl-a ug/cm^2), Ash-Free-Dry-Mass (AFDM mg/L), and pH.

Sample #	Fluorimeter	DOC	F:DOC	Conductivity	SRP	NO3	NH4	Chl-a	AFDM	pH
1	4.80	1.37	3.50	107.20	2.74	126.29	14.59	1.65	2.29	8.58
2	4.80	1.18	4.06	105.30	4.98	127.15	11.16	2.36	1.53	8.54
3	4.80	2.17	2.21	103.80	19.73	128.29	42.31	1.94	1.19	8.52
4	5.80	1.20	4.84	104.20	5.40	124.86	8.62	1.04	1.39	8.53
5	6.50	1.25	5.18	104.60	1.90	128.29	7.52	4.24	0.87	8.66
6	5.50	1.55	3.55	102.60	68.33	118.57	8.4	3.20	0.98	8.57
7	5.50	1.33	4.13	102.20	2.66	103.78	8.4	2.36	1.52	8.87
8	10.00	1.28	7.79	152.30	2.66	172.59	11.16	10.89	2.02	8.71
9	7.20	1.17	6.17	169.90	2.32	77.56	7.41	2.91	1.31	9.04
10	5.60	1.08	5.17	121.30	3.20	64.7	6.65	2.79	1.52	9.20
11	6.30	1.49	4.23	118.40	2.32	85.99	7.3	2.10	1.33	9.24
12	5.80	1.37	4.24	110.30	3.73	83.04	8.07	2.52	0.78	8.77
13	5.80	0.55	10.56	152.10	9.42	94.73	5.88	7.92	3.35	8.69
14	9.50	1.14	8.36	154.90	17.03	125.57	7.08	4.24	2.86	8.61
15	5.00	0.54	9.31	149.30	22.69	100.1	7.3	7.44	4.15	8.33
16	7.10	1.21	5.88	102.10	3.42	136.1	10.61	2.57	2.31	8.69
17	7.40	1.29	5.74	102.30	3.08	138.33	11.27	4.88	1.79	8.74
18	8.50	1.33	6.41	102.60	2.55	138.33	12.49	2.29	1.56	8.63
19	9.50	1.44	6.59	105.00	3.88	164.34	9.5	2.18	0.71	8.61
20	9.20	1.20	7.67	107.80	6.34	164.69	8.29	2.34	1.56	8.57
21	8.50	2.55	3.33	109.10	5.25	139.73	15.04	1.50	1.33	8.57
22	8.40	2.19	3.83	105.90	6.87	138.89	20.3	2.72	1.83	8.67
23	4.60	1.79	2.57	103.20	3.04	168.47	14.93	1.21	0.54	7.50
24	4.80	1.41	3.40	108.30	1.55	156.79	11.49	1.91	1.31	7.61
25	4.60	1.37	3.35	104.60	1.21	154.73	10.61	2.78	1.35	7.81
26	4.50	1.43	3.15	102.60	1.21	165.03	10.49	0.67	0.22	7.96
27	4.80	1.48	3.25	101.10	1.44	180.85	10.61	1.45	0.72	7.83
28	4.70	1.37	3.42	98.90	1.36	165.72	11.6	0.24	0.13	7.71
29	4.60	1.57	2.92	99.30	1.40	162.97	12.6	1.45	1.13	7.94

leachates entering the lake. However, we found some locations that strongly suggest a potential septic leachate problem in the nearshore areas of Lake McDonald.

First, we did not observe evidence of shoreline leachates in the data associated with sample sites 1-5, which were along the Apgar shoreline east of McDonald Creek lake outlet (See Appendix A – Fig. A1 [Section S1]). Nor did we see evidence of leachates at the far north end of the lake near the McDonald Creek inflow to the lake (sample sites 23-24) (See Appendix A – Fig. A10 [Section N7]). The sample sites along the northeast shoreline from sample sites 25-28 that include the shorelines near the Lake McDonald lodge also showed no evidence of leachates (See Appendix A – Fig. A12 through A16 [Sections N9 – N13]). Likewise, while we were sampling in the field along the shoreline at the northwest corner of the lake, shown in Appendix Figures A6 through A9 (Sections N3-N6) we observed no evidence of increased algal growth or increased fluorimetric readings. Thus, we did not collect nutrient samples in this area.

We did, however, see evidence of leachates along the southshore in front of the cabins extending west of the Lake McDonald outlet between sample sites 6 – 15 (See Appendix A – Fig. A2 and A3 [Sections S2 – S3]). Here the evidence is a combination of high F:DOC ratios, increased conductivity, nutrients and algal pigments and biomass. We also saw evidence of increased nutrients and algal biomass potentially as a result of septic leachates along the shoreline of Kelly camp (See Appendix A – Fig. A4 and A5 [Sections N1 – N2]).

Remotely Sensed Data and Classification

The remotely sensed, airborne high resolution and hyperspectral data were georectified and analyzed and classified for algal spectral signatures. We observed “hot-spots” of algal productivity that corresponded to our fluorimetric, water chemistry and field-collected algal biomass data at selected sites along the developed shoreline of the lake. We observed no evidence of high algal production from the remote sensing data associated with sample sites 1-5; along the Apgar shoreline east of McDonald Creek lake outlet; Figure 4 (also see Appendix A Fig A1).

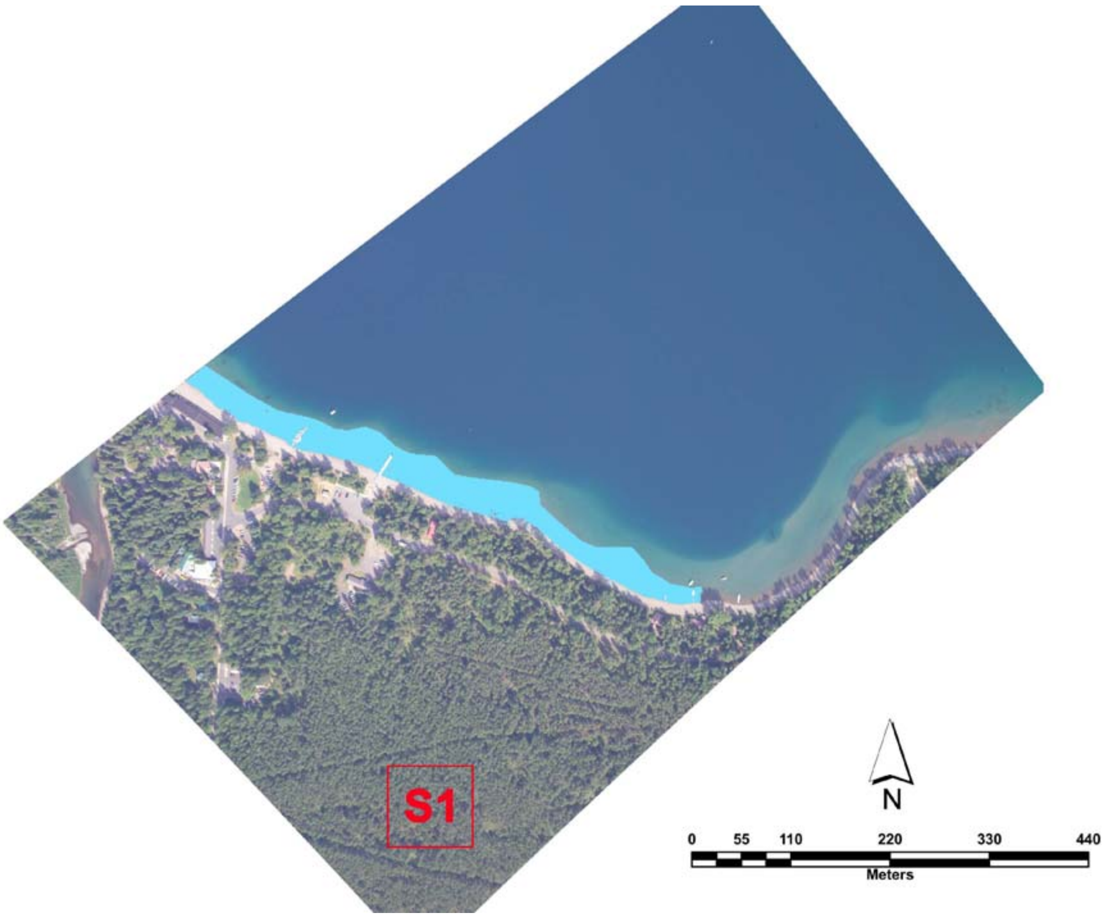

Figure 4. Classified image of Section S1, South Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, orange = diatom reflectance, red = green algal reflectance.

Nor did we see evidence of leachates at the far north end of the lake near the McDonald Creek inflow to the lake (sample sites 23-24); Figure 5 (also see Appendix A – Fig. A10 [Section N7]). Likewise, the sample sites along the northeast shoreline from sample sites 25-28 that include the shorelines near the Lake McDonald lodge also showed no evidence of leachates, although we did observe patches of what appeared to be more dense diatom growth (shown in yellow classification); Figures 6 - 10 (also see Appendix A – Fig. A12 through A16 [Sections N9 – N13]).

Figure 5. Classified image of Section N8, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, orange = diatom reflectance, red = green algal reflectance.

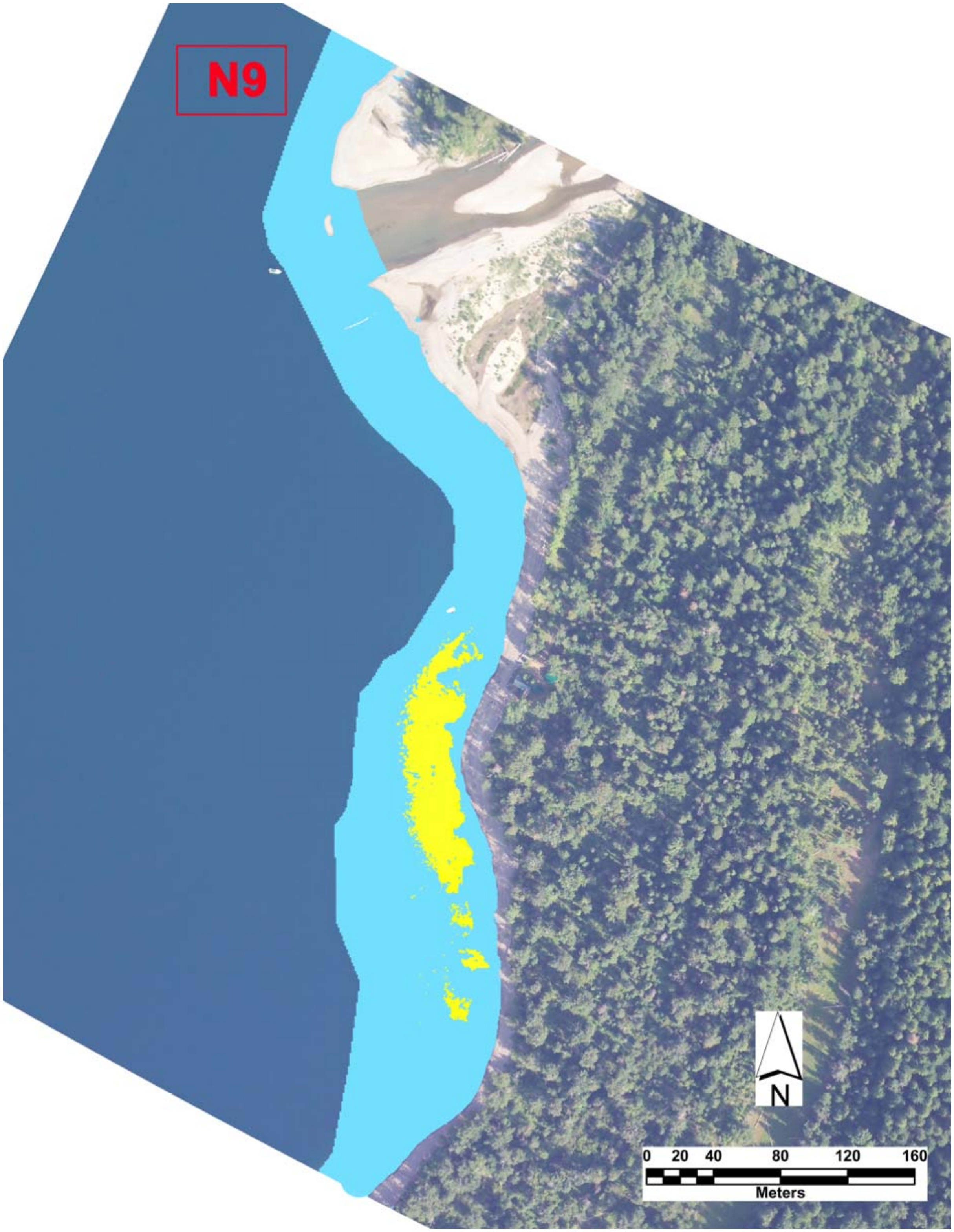

Figure 6. Classified image of Section N9, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance.

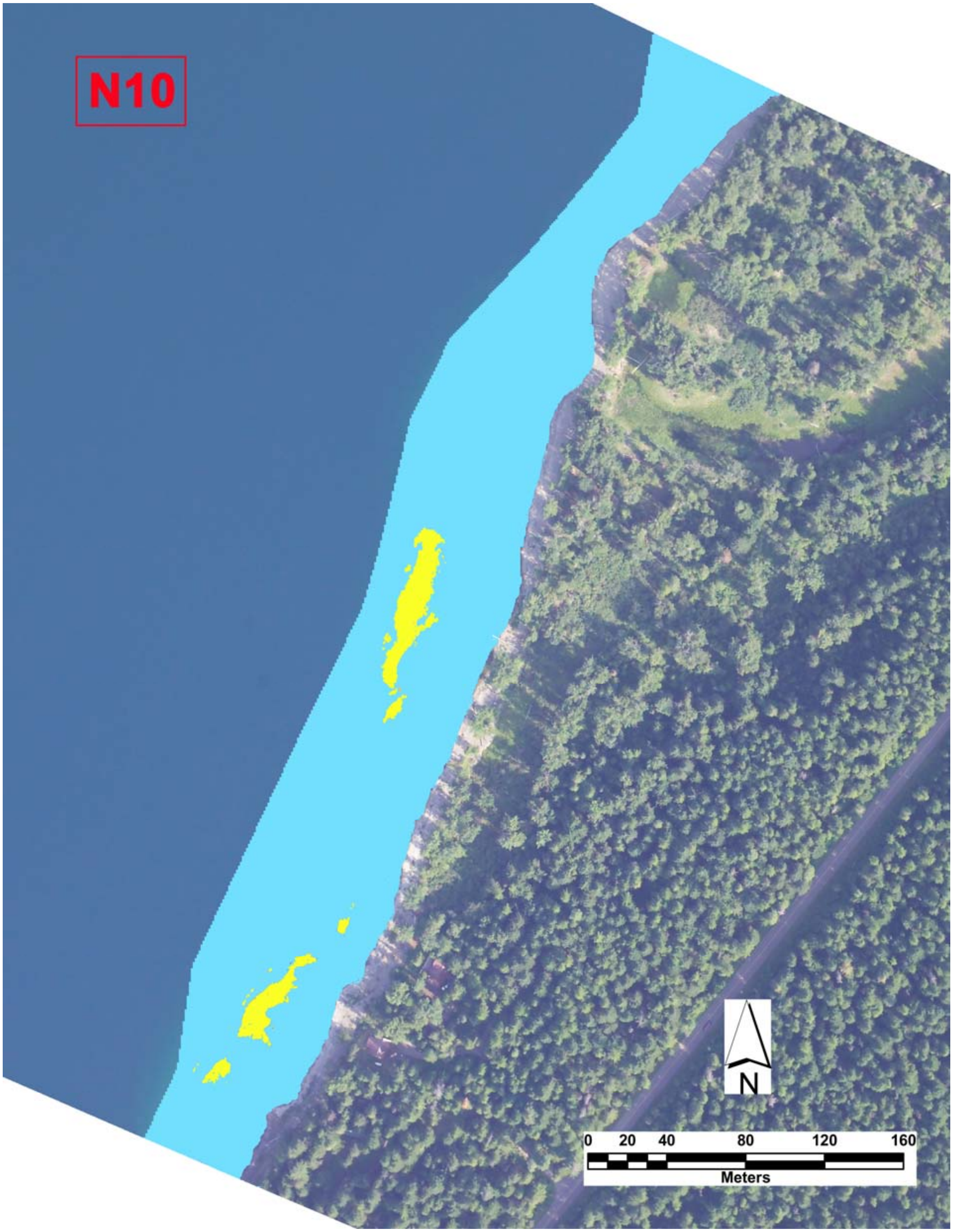

Figure 7. Classified image of Section N10, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance.

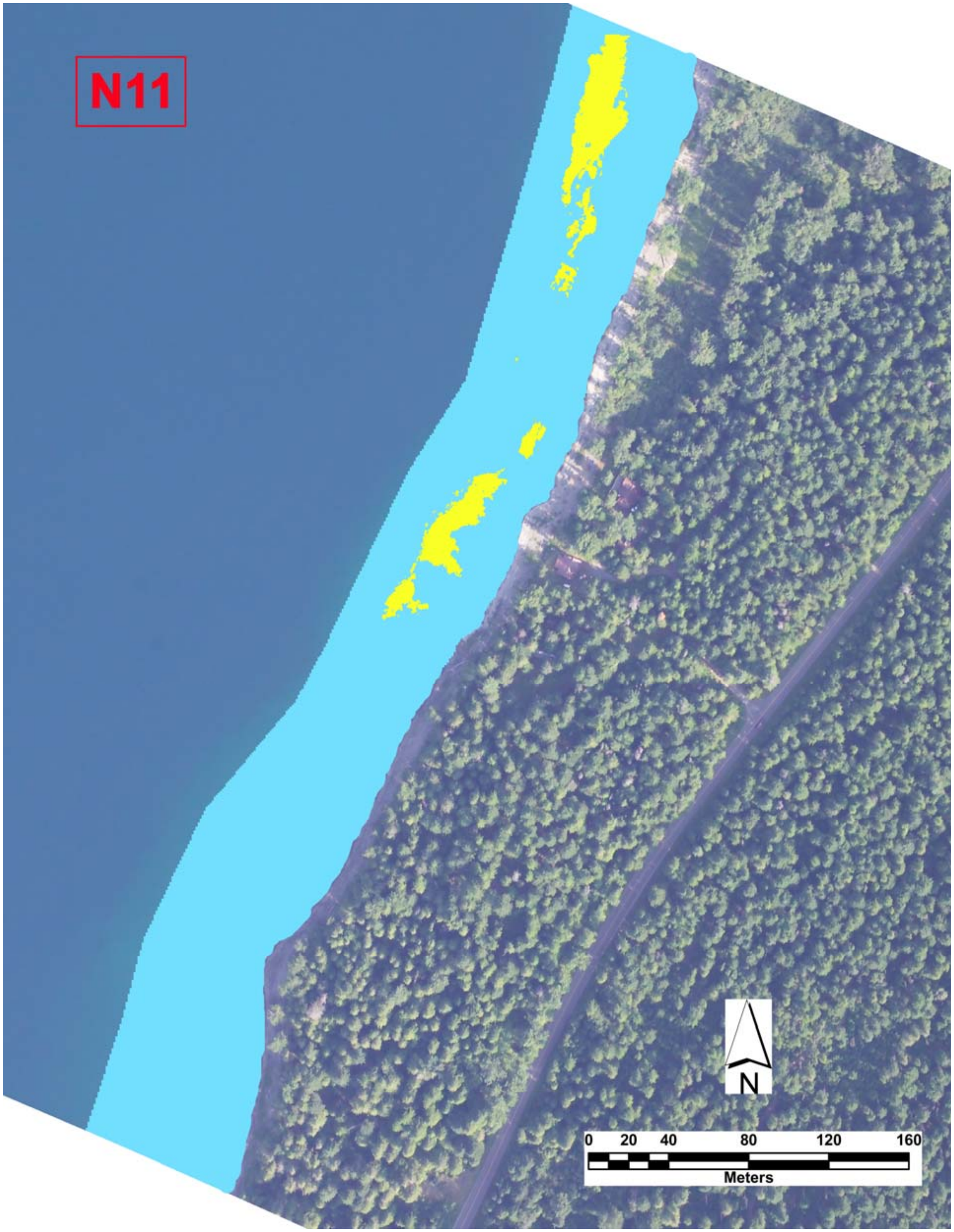

Figure 8. Classified image of Section N11, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance.

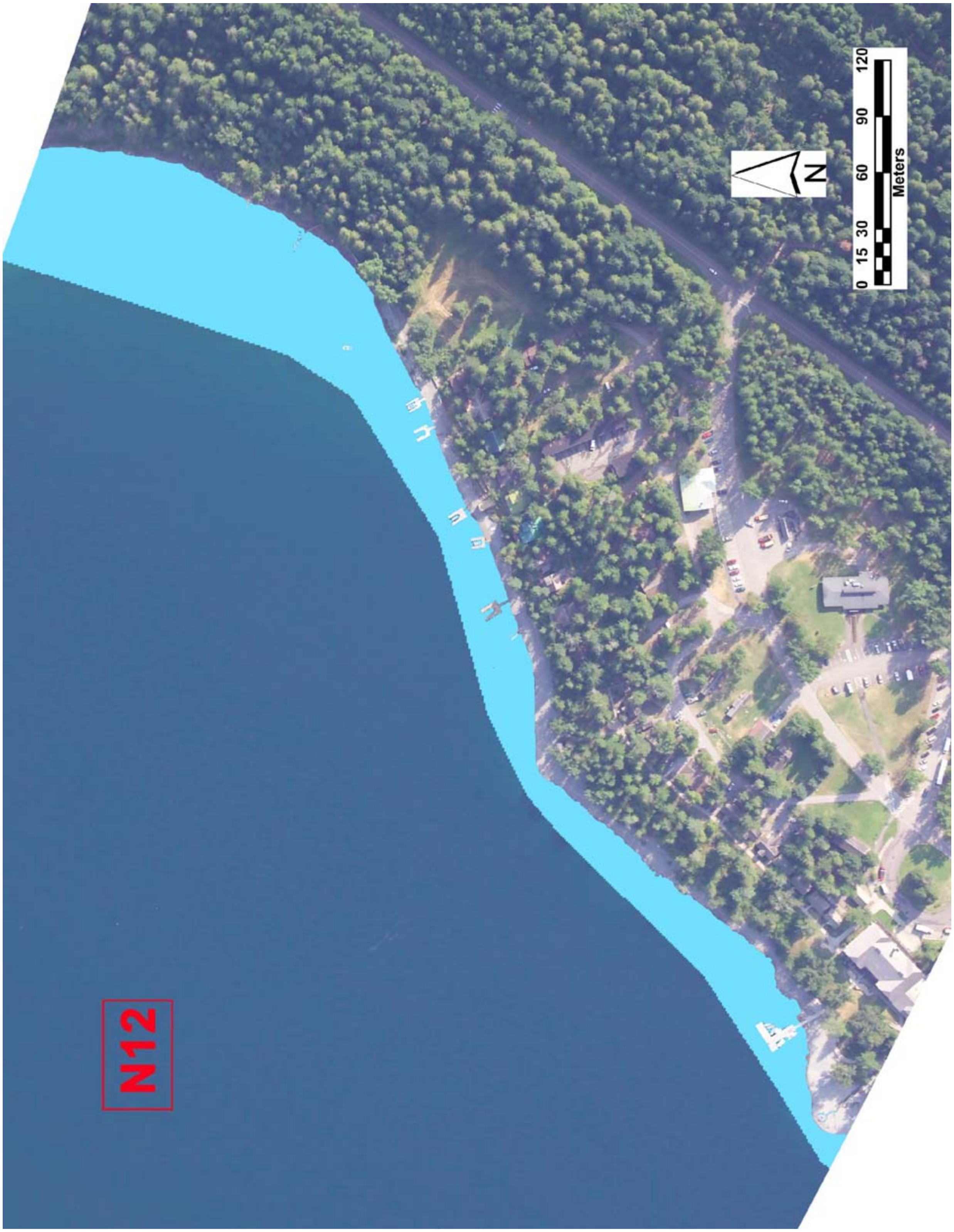

Figure 9. Classified image of Section N12, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance.

Figure 10. Classified image of Section N13, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance.

Corroborating the fluorimetric, water chemistry, and field algal sampling data, we observed green algal spectral reflectance along the shoreline in Sections S2 and S3. Herein, we present close-up, classified images of the shorelines showing sites of increased green algal production (Figs. 11 and 12)[also see Appendix A, Figs A2 and A3 for spatial reference].

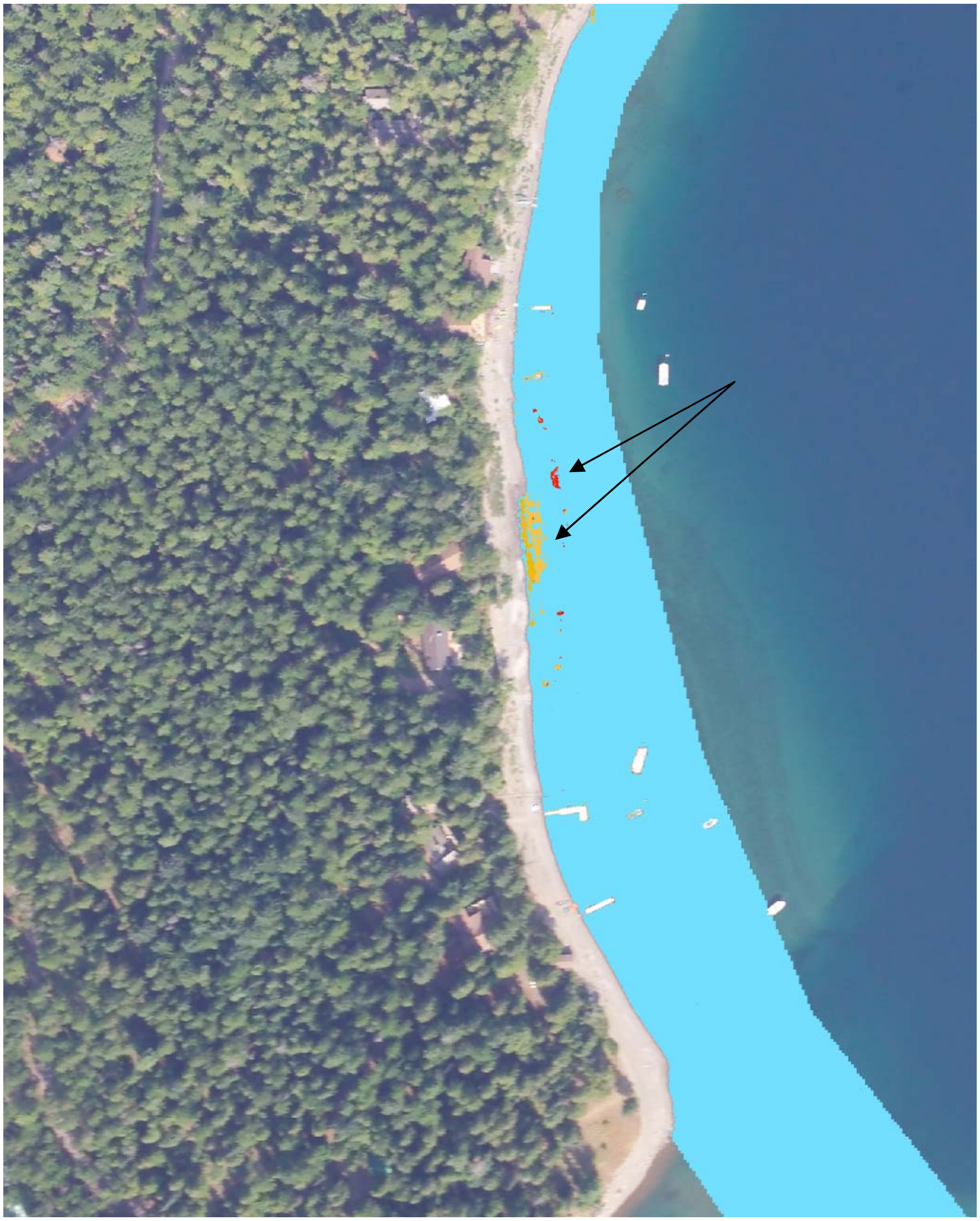

Figure 11. Classified image of Section S2, South Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance. See also Appendix A, Figure A3. Arrows indicate sites of increased algal biomass.

Figure 12. Classified image of northern end of Section S3, South Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance. See also Appendix A, Figure A3. Arrows indicate sites of increased algal biomass.

We also observed a corroboration of fluorimetric, water chemistry, and field algal growth data with the spectral reflectance of the remotely sensed data near Kelly camp along the northwest shoreline (Figs 13 and 14) [also see Appendix A, Figs A4 and A5 for spatial reference].

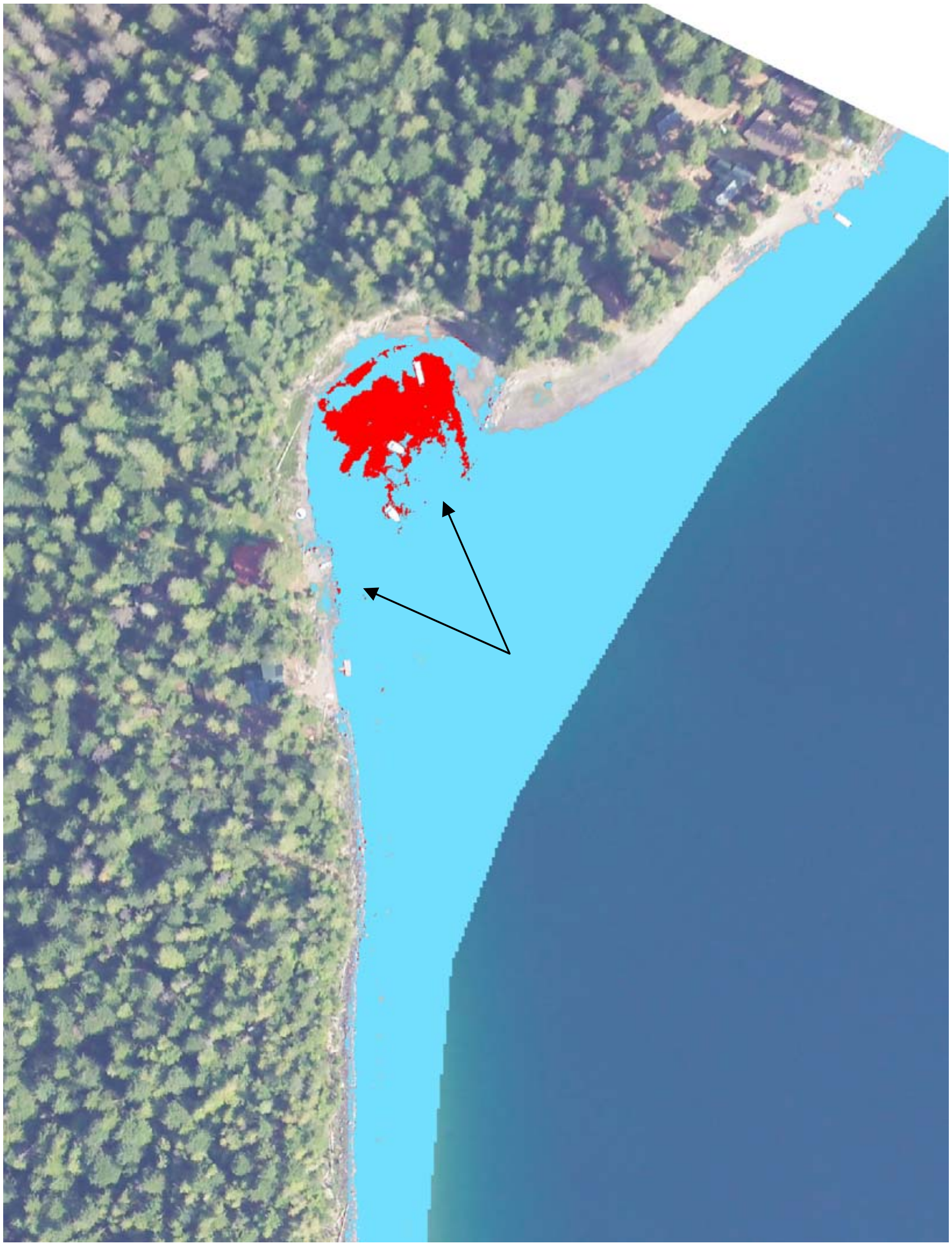

Figure 13. Classified image of Kelly camp area Section N1, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance. See also Appendix A, Figure A4. Arrows indicate sites of increased algal biomass.

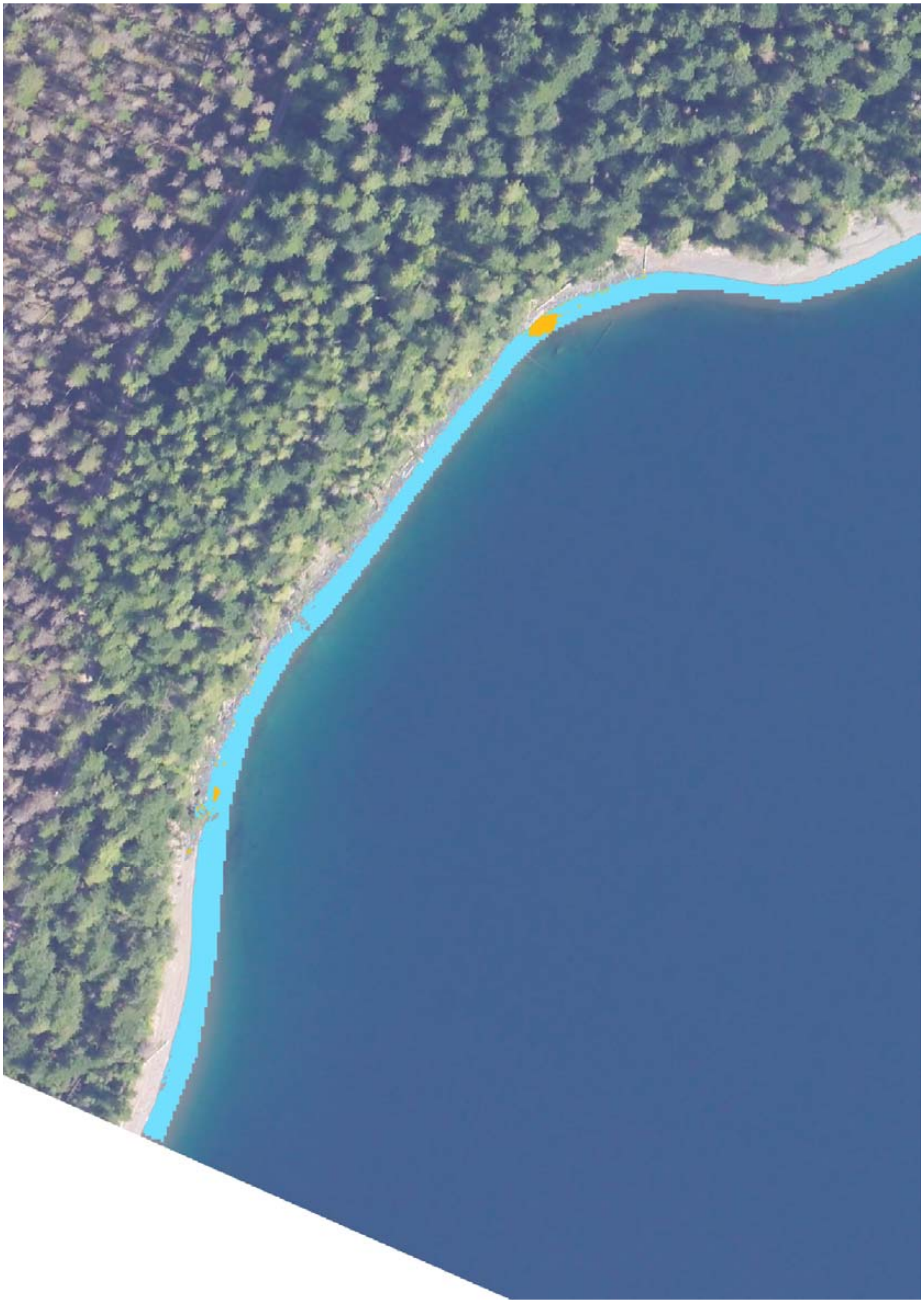

Figure 14. Classified image of northern Kelly camp area Section N2, North Lake McDonald. The shoreline has been analyzed for algal spectral signature. Light blue = no-low algal reflectance, yellow = diatom reflectance, red = green algal reflectance. See also Appendix A, Figure A5

Direct Dye Study

No NPS staff, GNP Rangers, in-holding land owners, nor I observed any dye along the shoreline during the week following the scheduled dye introductions in 2006. We did not observe any strong evidence of septic leachates entering Lake McDonald along the south shoreline east of the lake outlet, nor did we observe evidence of leachates along the far north end of the lake or along the shoreline between the lake inlet and the Lake McDonald lodge. However, following the study period, several in-holding land owners reported that they were either unable or unwilling to comply with the dye introductions.

We did, however, observe both chemical and biological evidence in the form of increased nutrients and algal growth in selected areas (see above) suggesting a strong potential of septic leachates entering the lake along the southwest shoreline of the lake (i.e., north of the lake outlet) and at Kelly camp around the small bay at the south end of the camp area. Because of this evidence, we focused a repeat of portions of the dye study (described above) in 2007.

We introduced tracer dye into a suite of cottage septic systems known to not be hooked up to the GNP sewer system corresponding specifically to the sites in the lake showing both chemical and biological evidence of possible septic leachates reaching the lake shoreline. Dye was administered either by FLBS or GNP staff. Neither GNP nor FLBS staff observed, nor any local residents reported, any evidence of dye entering the lake along the Kelly camp area. At the southwest shoreline north of the lake outlet, we observed only one location where dye surfaced from the septic system to enter surface waters (Fig 15). In this case, the dye erupted near the septic tank and flowed into the nearby creek and down to the lake. GNP staff took immediate action as this was clear evidence of septic system failure and constituted a significant health risk.

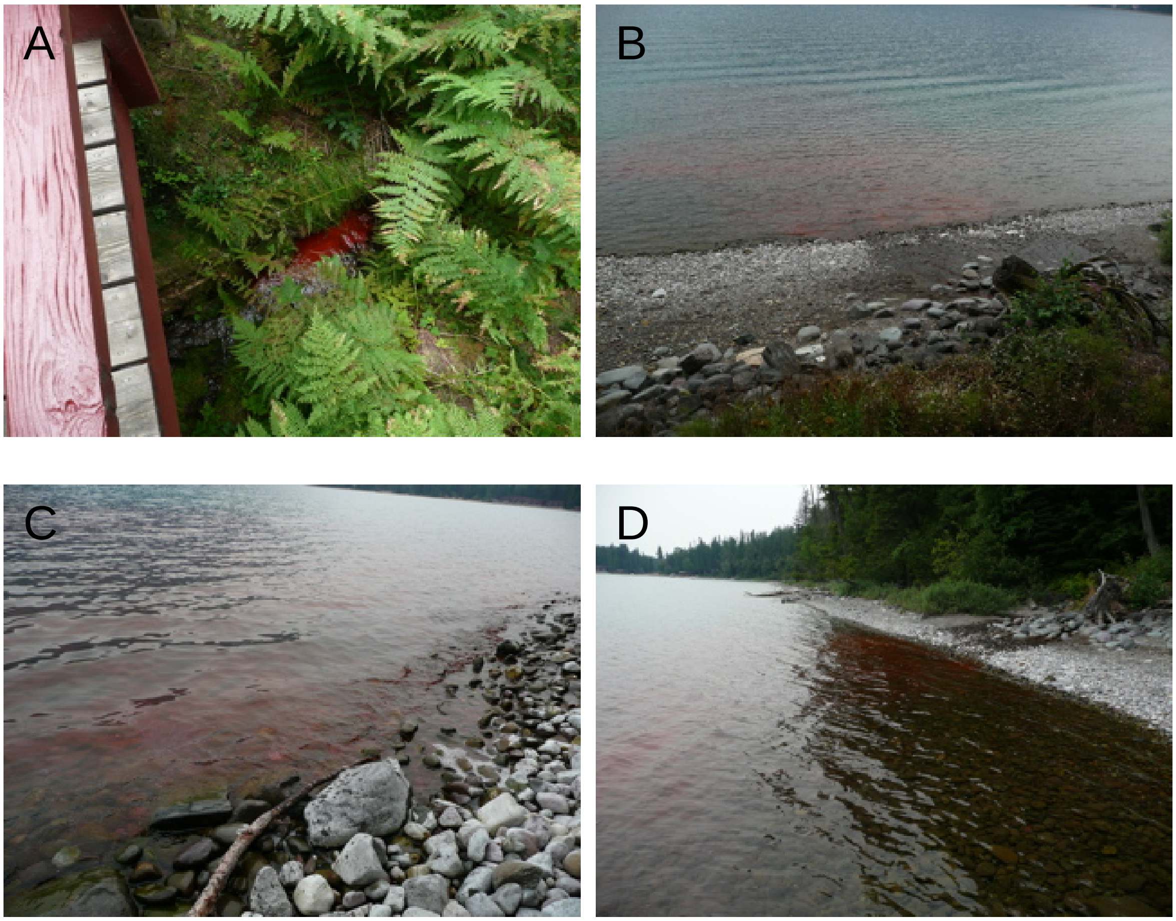

Figure 15. A). Tracer Dye as it appeared in creek running near septic field breakout. B). Tracer Dye at shoreline of lake at creek entrance to the McDonald Lake shoreline. C) Tracer Dye along shoreline in front of failed septic system. D) Tracer Dye extending onto McDonald Lake showing creek entrance along shoreline.

This study confirmed one location of complete septic system failure along the Lake McDonald shoreline. While this site was identified as having increased nutrients and algal biomass in the lake prior to the 2007 tracer dye study; it is not the only site along the lake showing elevated nutrients and increased algal growth. The elevated nutrients and algal growth in these other locations could be the result of natural processes, such as increased loading from the burned forest along Howe Ridge. However, they could also be the result of very slow leakage of nutrients from septic leach fields that would not be expected to show the tracer dye.

RECOMMENDATIONS

Lake McDonald is one of the most oligotrophic large lakes in the conterminous United States. Limnological studies preceding this investigation extending back into the early 1980's have demonstrated particularly low concentrations of biologically available phosphorus, low algal productivity, and very high water clarity. In spite of this extremely high water quality and clarity, we observed numerous locations associated with shoreline homes and cottages that had elevated levels of shoreline algal growth. These seasonally used cottages and homes distributed along the shoreline have the potential to contribute undesirable levels of nutrients into groundwaters that flow to the lake. The connection between increased nutrients in shoreline groundwaters and increased algal growth along shoreline rocks has been well known in the limnological literature for over 30 years.

In this study, we found numerous shoreline locations that indicate increased algal growth with elevated nutrient concentrations as a likely cause. The risk of contributing domestically generated nutrients is particularly acute among those domiciles that are not hooked up to the Glacier Park sewer collection and processing facility.

In the follow-up tracer dye study conducted in summer 2007, we found only one home that could be definitively identified as having a failed septic system. The Resource Management of Glacier Park took immediate action to prevent any further use of the home until remedial action is taken. Although only one home could be positively identified as having an acute and immediate dispersal of dye (and thus also raw sewage) into the lake shoreline, this does not mean that slow leaching of nutrients from septic fields does not occur.

I thus recommend the following:

- Many homes that are within reach of the existing sewage collection system between Lake McDonald Lodge area on the southeastern shore to the Fish Creek campground located on the northwestern shore are already connected to that collection system. However, several of the homes have not been connected to the central system. All homes that are within the central system area should be connected within the next 5 years.
- Septic leach fields have an exhaustion date after which they become very poor at processing sewage and removal of nutrients. Because of the sensitivity of Lake McDonald to nutrient pollution, homes not in the proximity of the GNP centralized sewage collection system should have their systems checked annually by a sanitation engineer. This should be done at the end of the summer season, which is the primary season of home use.

- Many of the locations around the lake have very shallow groundwaters. An integral part of keeping septic derived nutrients out of the lake is to have the septic leach fields away from the lake. Thus, all septic leach fields should be at least 200 meters away from the shoreline of the lake. Where this is not possible because the private properties are too small, the Park Administration should work with the home owners to facilitate a community-based leach field that is at least 500 meters from the lake shore. For example, there is a cluster of homes at Kelly Camp. Many of these homes do not have a single-home leach field that is at least 200 meters from the shore line. Thus, these homes may need to enter into a cooperative agreement with each other and with the Park to establish a community leach field.